PATENT ABSTRACTS OF JAPAN

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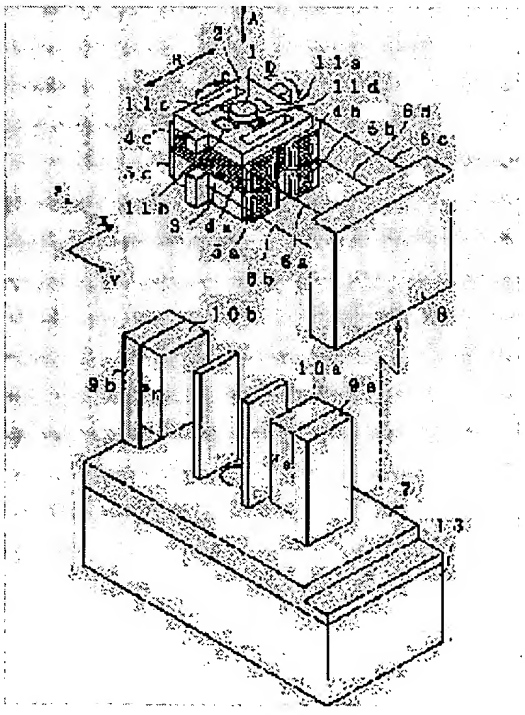
(54) OPTICAL DISK DEVICE

(57)Abstract:

PURPOSE: To eliminate the deterioration of signal quality caused by the inclination of the recording surface of a disk and the optical axis of a beam, and to correct the inclination of the optical axis of the beam with reference to the change of warpage amount caused while a disk rotates once, at a high speed.

CONSTITUTION: Tilt coils 5a to 5d are attached to the side surface of an objective lens holder 2. Magnets 10a and 10b, U-shaped yokes 9a and 9b, and supporting materials 6a to 6h supporting the objective lens holder 2 so that it can be freely tilted are attached to a pedestal 7. The inclination of the optical axis of the beam projected from an objective lens 1 and the recording surface of the optical disk 12 is detected by diameter direction inclination detectors 11a and 11b and circumferential direction inclination detectors 11c and 11d. Based on an error signal from the inclination detector, the tilt coils 5a to 5d are energized and the optical axis of the objective lens 1 is corrected at a high speed.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The objective lens which condenses light to an optical disk, and the object lens holder holding said objective lens, The supporting material which supports said object lens holder free [jogging] including two or more elastic bodies in the direction of a focus of said optical disk, and the direction of tracking and the inclination direction of the optical axis of said objective lens, The optical axis of the light emitted from said objective lens, the recording surface of said optical disk, and a hoop direction inclination detection means to detect an include-angle gap of a hoop direction, The optical axis of the light emitted from said objective lens, the recording surface of said optical disk, and a direction inclination detection means of a path to detect an include-angle gap of the direction of a path, The pedestal which fixes said supporting material, and the focal coil which is wound around the side face of said object lens holder, and drives said object lens holder in the direction of a focus, Two or more tracking coils which are the side faces of said object lens holder, fix on the side face which carries out phase opposite in the hoop direction of said optical disk, or the direction of a path, and drive said object lens holder in the direction of tracking, Two or more tilt coils which are the side faces of said object lens holder, fix on the side face which counters in the hoop direction or the direction of a path of said optical disk, and drive said object lens holder in the inclination direction of said optical axis, The magnetic impression means arranged at said pedestal so that said tracking coil and said tilt coil may be countered, The optical disk unit characterized by providing the tilt coil control circuit which controls the drive current passed in said each tilt coil based on the output of said hoop direction inclination detection means and the direction inclination detection means of a path, and amends the inclination of the optical axis of said objective lens, the hoop direction of said optical disk, and the direction of a path.
[Claim 2] The 4th tilt coil is arranged on all sides, respectively. said tilt coil -- a core [optical axis / of said objective lens] -- the 1- with the 1st and 2nd tilt coils The 3rd and 4th tilt coils are attached along the direction of a path of said optical disk. The 2nd and the 4th tilt coil, It is that in which the 1st and 3rd tilt coils are attached along the hoop direction of said optical disk. Said tilt coil control circuit A subtraction means to subtract the signal of said hoop direction inclination detection means from the signal of said direction inclination detection means of a path, and to change the subtraction value into the drive current of said 1st and 4th tilt coils, The optical disk unit according to claim 1 characterized by being what has an addition means to add the signal of said direction inclination detection means of a path, and the signal of said hoop direction inclination detection means, and to change the aggregate value into the drive current of said 2nd and 3rd tilt coils.
[Claim 3] The objective lens which condenses light to an optical disk, and the object lens holder holding said objective lens, The supporting material which supports said object lens holder free [jogging] including two or more elastic bodies in the direction of a focus of said optical disk, and the direction of tracking and the inclination direction of the optical axis of said objective lens, The optical axis of the light emitted from said objective lens, the recording surface of said optical disk, and a hoop direction inclination detection means to detect an include-angle gap of a hoop direction, The optical axis of the light emitted from said objective lens, the recording surface of said optical disk, and a direction

inclination detection means of a path to detect an include-angle gap of the direction of a path, A focal detection means to detect a gap of the direction of a focus of said objective lens and said optical disk, The pedestal which fixes said supporting material, and two or more tracking coils which are the side faces of said object lens holder, fix on the side face which carries out phase opposite in the hoop direction of said optical disk, or the direction of a path, and drive said object lens holder in the direction of tracking, Two or more voice coils which are the side faces of said object lens holder, fix on the side face which counters in the hoop direction or the direction of a path of said optical disk, and drive said object lens holder in the direction of tracking of said optical disk, a hoop direction, and the direction of a path, The magnetic impression means arranged at said pedestal so that said tracking coil and said voice coil may be countered, Based on the output of said hoop direction inclination detection means, the direction inclination detection means of a path, and said focal detection means, the drive current passed to said two or more voice coils is controlled. Inclination amendment of the optical axis of said objective lens, the hoop direction of said optical disk, and the direction of a path, The optical disk unit characterized by providing the voice coil control circuit which performs focal amendment of said coherent light to coincidence.

[Claim 4] As for said voice coil, the 1st - the 4th voice coil are arranged on all sides centering on the optical axis of said objective lens, respectively. The 1st and 2nd voice coils, The 3rd and 4th voice coils are attached along the direction of a path of said optical disk. The 2nd and the 4th tilt coil, It is that in which the 1st and 3rd tilt coils are attached along the hoop direction of said optical disk. Said voice coil control circuit The 1st operation means which subtracts the signal of said hoop direction inclination detection means, and the signal of said focal detection means from the signal of said direction inclination detection means of a path, and changes the operation value into the drive current of said 4th voice coil, The 2nd operation means which subtracts the signal of said hoop direction inclination detection means from the sum of the signal of said direction inclination detection means of a path, and the signal of said focal detection means, and changes the operation value into the drive current of said 1st voice coil, The 3rd operation means which subtracts the signal of said focal detection means from the sum of the signal of said direction inclination detection means of a path, and the signal of said hoop direction inclination detection means, and changes the operation value into the drive current of said 2nd voice coil, The optical disk unit according to claim 3 characterized by being what has the 4th operation means which adds the signal of said direction inclination detection means of a path, the signal of said hoop direction inclination detection means, and the signal of said focal detection means, and changes the operation value into the drive current of said 3rd voice coil.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the optical disk unit which enabled it to amend the inclination of the beam optical axis over a disk recording surface at a high speed in a compact disc player (CD player), a laser disc player (LD player), etc.
[0002]
[Description of the Prior Art] In optical disk regenerative apparatus, such as a CD player and LD player, if the optical axis of a signal regeneration beam leans to the optical disk playback side, optical aberration will occur, a cross talk will increase and a regenerative signal will deteriorate. Moreover, when the optical axis of a signal record beam leans to the optical disk recording surface in the optical disk record regenerative apparatus, degradation of a record signal may be produced and a mistake may be produced in pit formation.
[0003] In the conventional LD player etc., the camber of the direction of a path of a disk is detected as an average amount of camber of a disk round. And there are some in which the tilt control unit which leans the whole optical pickup and controls a beam optical axis by tilt motors, such as a DC motor, was attached.
[0004] In recent years, as for the optical disk unit, high density record-ization is progressing. In order to raise resolution and to perform record playback of high density, an objective lens with large (that is, aperture is large) numerical aperture (NA) is used. However, when aperture of an objective lens was enlarged and the inclination of the beam optical axis over an optical disk playback side arises, the degree of comatic aberration becomes large in proportion to the cube of NA, and the problem that change of the amount of camber under disk round has a bad influence on the record reproducing characteristics of a signal arises.
[0005]
[Problem(s) to be Solved by the Invention] However, in the optical disk unit which has the tilt control device mentioned above, since the inclination of the whole optical pickup was controlled by a DC motor etc., the response was bad, and tilt control of an optical pickup was not able to be performed so that it might correspond to change of the amount of camber in each include angle while a disk rotates.
[0006] This invention is made in view of such a conventional trouble, and it aims at realizing the optical disk unit which can amend the inclination to the disk recording surface of a beam optical axis at a high speed corresponding to change of the amount of camber under disk round.
[0007]
[Means for Solving the Problem] The objective lens with which invention of claim 1 of this application condenses light to an optical disk, The object lens holder holding an objective lens, and the supporting material which supports an object lens holder free [jogging] including two or more elastic bodies in the direction of a focus of an optical disk, and the direction of tracking and the inclination direction of the optical axis of an objective lens, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a hoop direction inclination detection means to detect an

include-angle gap of a hoop direction, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a direction inclination detection means of a path to detect an include-angle gap of the direction of a path, The pedestal which fixes supporting material, and the focal coil which is wound around the side face of an object lens holder, and drives an object lens holder in the direction of a focus, Two or more tracking coils which are the side faces of an object lens holder, fix on the side face which carries out phase opposite in the hoop direction of an optical disk, or the direction of a path, and drive an object lens holder in the direction of tracking, Two or more tilt coils which are the side faces of an object lens holder, fix on the side face which counters in the hoop direction or the direction of a path of an optical disk, and drive an object lens holder in the inclination direction of an optical axis, The magnetic impression means arranged at the pedestal so that a tracking coil and a tilt coil may be countered, Based on the output of a hoop direction inclination detection means and the direction inclination detection means of a path, the drive current passed in each tilt coil is controlled, and it is characterized by providing the tilt coil control circuit which amends the inclination of the optical axis of an objective lens, the hoop direction of an optical disk, and the direction of a path.
[0008] In invention of claim 2 of this application, a tilt coil The 4th tilt coil is arranged on all sides, respectively. a core [optical axis / of an objective lens] -- the 1- with the 1st and 2nd tilt coils The 3rd and 4th tilt coils are attached along the direction of a path of an optical disk. The 2nd and the 4th tilt coil, It is that in which the 1st and 3rd tilt coils are attached along the hoop direction of an optical disk. A tilt coil control circuit A subtraction means to subtract the signal of a hoop direction inclination detection means from the signal of the direction inclination detection means of a path, and to change the subtraction value into the drive current of the 1st and 4th tilt coils, The signal of the direction inclination detection means of a path and the signal of a hoop direction inclination detection means are added, and it is characterized by having an addition means to change the aggregate value into the drive current of the 2nd and 3rd tilt coils.
[0009] The objective lens with which invention of claim 3 of this application condenses light to an optical disk, The object lens holder holding an objective lens, and the supporting material which supports an object lens holder free [jogging] including two or more elastic bodies in the direction of a focus of an optical disk, and the direction of tracking and the inclination direction of the optical axis of an objective lens, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a hoop direction inclination detection means to detect an include-angle gap of a hoop direction, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a direction inclination detection means of a path to detect an include-angle gap of the direction of a path, A focal detection means to detect a gap of the direction of a focus of an objective lens and an optical disk, The pedestal which fixes supporting material, and two or more tracking coils which are the side faces of an object lens holder, fix on the side face which carries out phase opposite in the hoop direction of an optical disk, or the direction of a path, and drive an object lens holder in the direction of tracking, Two or more voice coils which are the side faces of an object lens holder, fix on the side face which counters in the hoop direction or the direction of a path of an optical disk, and drive an object lens holder in the direction of tracking of an optical disk, a hoop direction, and the direction of a path, The magnetic impression means arranged at the pedestal so that a tracking coil and a voice coil may be countered, Based on the output of a hoop direction inclination detection means, the direction inclination detection means of a path, and a focal detection means, the drive current passed to two or more voice coils is controlled. Inclination amendment of the optical axis of an objective lens, the hoop direction of an optical disk, and the direction of a path, It is characterized by providing the voice coil control circuit which performs focal amendment of coherent light to coincidence.
[0010] In invention of claim 4 of this application, a voice coil The 1st - the 4th voice coil are arranged on all sides centering on the optical axis of an objective lens, respectively. The 1st and 2nd voice coils, The 3rd and 4th voice coils are attached along the direction of a path of an optical disk. The 2nd and the 4th tilt coil, It is that in which the 1st and 3rd tilt coils are attached along the hoop direction of an optical disk. A voice coil control circuit The 1st operation means which subtracts the signal of a hoop direction

inclination detection means, and the signal of a focal detection means from the signal of the direction inclination detection means of a path, and changes the operation value into the drive current of the 4th voice coil, The 2nd operation means which subtracts the signal of a hoop direction inclination detection means from the sum of the signal of the direction inclination detection means of a path, and the signal of a focal detection means, and changes the operation value into the drive current of the 1st voice coil, The 3rd operation means which subtracts the signal of a focal detection means from the sum of the signal of the direction inclination detection means of a path, and the signal of a hoop direction inclination detection means, and changes the operation value into the drive current of the 2nd voice coil, The signal of the direction inclination detection means of a path, the signal of a hoop direction inclination detection means, and the signal of a focal detection means are added, and it is characterized by having the 4th operation means which changes the operation value into the drive current of the 3rd voice coil.
[0011]
[Function] According to invention of claim 1 of this application which has such a description, when the optical axis of an objective lens inclines in the hoop direction or the direction of a path of an optical disk, the direction of a path and a hoop direction inclination detection means output the inclination signal of the direction of a path, and a hoop direction, respectively. The control signal which should be distributed to each tilt coil is calculated using the inclination signal of these hoop directions and the direction of a path. If this result of an operation is changed into a drive current and each tilt coil is given, the optical axis of an objective lens and the inclination of an optical disk will be amended. Moreover, in order to perform amendment of the direction of a focus of an objective lens, and the direction of tracking, the periphery of an object lens holder **** and the drive current for servoes is given to a focal coil and a tracking coil. The drive current which flowed in the tilt coil, the focal coil, and the tracking coil is transformed into electromagnetic force by the magnetic impression means, and attitude control of the objective lens is carried out in the predetermined direction. If it carries out like this, the inclination to the disk recording surface of a beam optical axis can be amended at a high speed to change of the amount of camber under round at the time of rotation of an optical disk. Therefore, the comatic aberration in an objective lens decreases and record playback of a high-definition signal can be performed.
[0012] Moreover, according to invention of claim 4 of this application, two or more driven voice coils which carry out mutually-independent are prepared in the periphery side face of an object lens holder. If a drive current is given to these voice coils using the inclination signal and control signal which are detected, respectively with a hoop direction inclination detection means, the direction inclination detection means of a path, and a focal detection means, a focus servo can be performed without using a focal coil. Moreover, about tilt control of the hoop direction of an objective lens, and the direction of a path, it acts like invention according to claim 1. If it carries out like this, the class of coil attached in an object lens holder will decrease.
[0013]
[Example] The optical disk unit which contains the tilt control device in the 1st example of this invention below is explained referring to drawing 1 - drawing 5 . Drawing 1 is the decomposition perspective view showing the configuration of the principal part of the optical disk unit of the 1st example. Drawing 2 is the explanatory view which was attached in the optical disk unit and in which inclining and showing the principle of operation of a detection means. Drawing 2 (a) is an important section sectional view in case there is no inclination of a beam optical axis, and drawing 2 (b) is an important section sectional view when the inclination of a beam optical axis arises. Moreover, drawing 3 is the circuit diagram showing the configuration of a tilt coil control circuit, and drawing 4 is the perspective view showing arrangement of the tilt coil attached in the optical disk unit.
[0014] As shown in drawing 1 , the objective lens 1 of an optical pickup is held at the object lens holder 2. The focal coil 3 is horizontally wound around the side face of the object lens holder 2. As shown in drawing 1 , y and the direction of a path of an optical disk are set [the direction of an optical axis of an objective lens 1] to x for the hoop direction of z and an optical disk. In one side face of the hoop direction (the direction of y) of the object lens holder 2, tracking coil 4c and tracking coil 4d which is

not illustrated are attached also in the side face of the tracking coils 4a and 4b and another side. The tracking coils 4a-4d are coils wound around the spiral or the curled form, and are coils which pass the drive current for the truck servoes of an optical pickup.

[0015] It is the side face of the hoop direction of the object lens holder 2, and the tilt coils 5a-5d are attached in the part located in each tracking coils [4a-4d] lower part. As shown in drawing 4 , the 1st and 2nd tilt coil 5a and 5b and the 3rd and 4th tilt coil 5c and 5d are arranged along the direction of a path of an optical disk so that it may become a x axis and axial symmetry. In this case, the tilt coils 5a and 5c and the tilt coils 5b and 5d will be arranged along the hoop direction of an optical disk. The tilt coils 5a-5d are also coils wound around the spiral or the curled form, and are coils which pass the drive current for tilt control of an optical pickup. As shown in drawing 1 and drawing 4 , the tilt coils 5a and 5b fix to the near-side side of the object lens holder 2, and fix the tilt coils 5c and 5d on the side face of another side of the object lens holder 2. And as shown in drawing 4 , tilt coil 5a, and 5d, 5b and 5c are respectively connected to the serial.

[0016] Next, the four parallel straight-lines-like supporting material 6a, 6b, 6c, and 6d fixes an end on the side face of the object lens holder 2, and the other end has fixed to the supporting-material fixed part 8. As shown in drawing 1 , supporting material 6a-6d supports the object lens holder 2 possible [jogging and tilting in the four directions of the direction A of a focus (z-axis), the direction B of tracking (x axis), direction inclination C of a path, and hoop direction inclination D].

[0017] The supporting-material fixed part 8 is attached in a pedestal 7 where the object lens holder 2 is held flexibly. A pedestal 7 holds U character mold York 9a and 9b of a pair in the direction of y, and is attached in the upper part of the optical pickup body 13. York 9a and 9b constitutes the magnetic impression means with Magnets 10a and 10b.

[0018] On both sides of the objective lens 1, the direction inclination detectors 11a and 11b of a path are attached in the top face of the object lens holder 2 along x directions. Moreover, on both sides of the objective lens 1, the hoop direction inclination detectors 11c and 11d are attached along the direction of y. The inclination detectors 11a-11d are photo detectors which receive the diffracted light which does not return to an objective lens 1 among the light reflected with an optical disk 12, after coherent light is emitted from an objective lens 1 and condensed by the optical disk 12, as shown in drawing 2 (a) and (b).

[0019] Next, a tilt coil control circuit is explained using drawing 3 . The signal which inclined from the signal output of inclination detector 11a of drawing 1 , and subtracted the signal output of detector 11b with the subtractor 21 is made into the direction inclination signal a of a path. Moreover, the signal which inclined from inclination detector 11c and subtracted the signal output of 11d of detectors with the subtractor 22 is made into the hoop direction inclination signal b. The subtractor 23 of drawing 3 is the circuit which inclines from the inclination signal a and subtracts Signal b, and outputs the difference signal c (= a-b). Moreover, an adder 24 is the circuit which inclines with the inclination signal a and adds Signal b, and outputs the sum signal d (=a+b). The output of a subtractor 23 is changed into a drive current by the driver 25, and is given to a tilt coils [5a and 5d] series connection object. The output of an adder 24 is similarly changed into a drive current by the driver 26, and is given to the series connection object of the tilt coils 5b and 5c. When a current flows, the tilt coils 5a and 5d shall be connected here so that the electromagnetic force of hard flow may occur mutually. The same is said of the tilt coils 5b and 5d.

[0020] Actuation of the optical disk unit of the 1st example constituted as mentioned above is explained. The diffracted light which does not return to an objective lens 1 among the light which outgoing radiation was carried out from the objective lens 1, and condensed to the optical disk 12 as shown in drawing 1 is received by the direction inclination detectors 11a and 11b of a path, and the hoop direction inclination detectors 11c and 11d. When there is no inclination of a beam optical axis when the object lens holder 2 and an optical disk 12 are parallel namely, the quantity of light received with the two direction inclination detectors 11a and 11b of a path is equal without an objective lens's 1 inclining in the direction C of a path, as shown especially in drawing 1 . In this case, the value of the inclination signal a inputted into the tilt coil control circuit of drawing 3 is set to 0.

[0021] However, when the inclination of the direction of a path occurs in a beam optical axis when the object lens holder 2 and an optical disk 12 are not parallel namely, as shown in drawing 2 (b), a difference arises in the light income of the direction inclination detectors 11a and 11b of a path, and the direction inclination signal a of a path turns into a forward or negative signal according to the inclination direction and the amount of inclinations.
[0022] Moreover, the hoop direction inclination signal b occurs by 11d also about the hoop direction D shown in drawing 1 by hoop direction inclination detector 11c and the same principle as the above. These inclination signals a and b are inputted into the subtractor 23 and adder 24 of drawing 3 , and are changed into the difference signal c and the sum signal d. And the difference signal c is changed into a drive current by the driver 25, and this current is given to the tilt coils 5a and 5d of drawing 5 . Moreover, the Kazunobu number d is changed into a drive current by the driver 26, and this current is given to the tilt coils 5b and 5c.
[0023] electromagnetism with the magnetic circuit which consists of U character mold York 9a and 9b of drawing 1 , and magnets 10a and 10b -- according to an operation, as the arrow head of drawing 4 shows, the difference driving force F1 and F2 occurs in the tilt coils 5a and 5d, respectively. The sum driving force F4 and F3 occurs in the tilt coils 5b and 5c similarly, respectively. The difference driving force F1 and F2 turned to the opposite direction mutually, and the sum driving force F3 and F4 has also turned to the opposite direction mutually. Moreover, the difference driving force F1 and the sum driving force F3 turned to the same direction, and the difference driving force F2 and the sum driving force F4 have also turned to the same direction.
[0024] A radius of gyration is calculated for the angular moment of the direction C of a path generated in a lens holder 2 here as 1. In drawing 4 , the angular moment according from the y-axis of an objective lens 1 to the tilt coils 5a and 5c of a near side is F1+F3, and the angular moment according from the y-axis of an objective lens 1 to the tilt coils 5b and 5d of the opposite side is F2+F4. Therefore, the comprehensive angular moment Fr of the direction of a path which sets a revolving shaft as the y-axis becomes the following (1) type.

$$Fr=(F1+F3)+(F2+F4)$$
$$=\{(a-b)+(a+b)\}$$
$$+\{(a-b)+(a+b)\}$$
$$=4a \quad \ldots (1)$$

[0025] Moreover, a radius of gyration is calculated for the angular moment of the hoop direction D generated in a lens holder 2 as 1. In drawing 4 , the angular moment according from the x axis of an objective lens 1 to the tilt coils 5c and 5d of the opposite side is F3-F2, and the angular moment according from the x axis of an objective lens 1 to the tilt coils 5b and 5a of a near side is F4-F1. Therefore, the comprehensive angular moment Ft of the hoop direction which sets a revolving shaft as a x axis becomes the following (2) types.

$$Ft=(F3-F2)+(F4-F1)$$
$$=\{(a+b)-(a-b)\}$$
$$+\{(a+b)-(a-b)\}$$
$$=4b \quad \ldots (2)$$

[0026] (1) 4a of a formula is what amplified the direction inclination signal a of a path, and it turns out that the drive current proportional to the inclination of the direction of a path is given to the tilt coils 5a-5d, and the inclination of the direction C of a path of the objective lens 1 to an optical disk 12 is controlled. Moreover, 4b of (2) types is what amplified the hoop direction inclination signal b, and it turns out that the drive current proportional to the inclination of a hoop direction is given to the tilt coils 5a-5d, and the inclination of the hoop direction D of an objective lens 1 is controlled. As for the object lens holder 2, a specified quantity inclination and the inclination of an optical disk 12, the direction of a path of a light beam optical axis, and a hoop direction are amended by the direction C of a path of a disk, and the hoop direction D of a disk as mentioned above, respectively.
[0027] On the other hand, the parallel displacement of the object lens holder 2 is carried out in the direction of tracking by carrying out suitable energization for the tracking coils 4a-4d. For this reason,

the tracking of the light beam which irradiates an optical disk 12 through an objective lens 1 can be adjusted. moreover -- if suitable energization for the focal coil 3 is performed -- electromagnetism -- the object lens holder 2 carries out a parallel displacement in the direction of a focus according to an operation. Thus, the focus of the light beam which irradiates an optical disk 12 through an objective lens 1 can be adjusted.

[0028] The inclination signal generated as mentioned above with the direction inclination detectors 11a and 11b of a path and the hoop direction inclination detectors 11c and 11d is given to a tilt coil control circuit, those sum signals and difference signals are built, and it energizes based on these to two tilt coils 5a and 5c and 5b and 5d. If it carries out like this, a high speed can be compensated for the optical-axis inclination of the light beam emitted from an objective lens 1 to inclination change of the direction of a path under round of the rotating optical disk, and a hoop direction. By the further above-mentioned configuration, the attitude control of the direction of a path and a hoop direction can be used together with two pairs of tilt coils, and a tilt control unit can be made into a low price by that which can perform reduction of components mark.

[0029] Next, it attaches about the optical disk unit containing the tilt control device in the 2nd example of this invention, and it explains, referring to drawing 5 - drawing 7 . Drawing 5 is the decomposition perspective view showing the configuration of the principal part of the optical disk unit of the 2nd example. Drawing 6 is the circuit diagram showing the configuration of a voice coil control circuit, and drawing 7 is the important section perspective view of the voice coil attached in the optical disk unit of the 2nd example.

[0030] In drawing 5 - drawing 7 , the same sign is attached to the configuration member which has the same function as the 1st example, and those explanation is omitted. A different part from the 1st example is the point of transposing the focal coil 3 and the tilt coils 5a-5d of drawing 1 to the voice coils 30a, 30b, 30c, and 30d which became independent electrically, and making the focal coil and the tilt coil serve a double purpose.

[0031] In drawing 5 , it is the side face of the hoop direction of the object lens holder 2, and voice coils 30a-30d are attached in the part located in the tracking coils [4a-4d] lower part. As shown in drawing 7 , it is arranged along the direction of a path of an optical disk the 1st voice coil 30a and 2nd voice coil 30b, and the 3rd voice coil 30c and 4th voice coil 30d so that it may become a x axis and axial symmetry. In this case, voice coils 30a and 30c and voice coils 30b and 30d will be arranged along the hoop direction of an optical disk. Voice coils 30a-30d are also coils wound around the spiral or the curled form, and are coils which pass the drive current tilt control of an optical pickup, and for focal control. As shown in drawing 5 and drawing 7 , voice coils 30a and 30b fix on the side face of the near side of the object lens holder 2, and fix voice coils 30c and 30d on the side face of another side of the object lens holder 2. And as shown in drawing 7 , voice coils 30a, 30b, 30c, and 30d are connected to the driver so that a drive current may be supplied independently.

[0032] The voice coil control circuit of the optical disk unit of the 2nd example constituted as mentioned above is explained. In addition, since the detection approach of an inclination detecting signal is the same as that of the 1st example, explanation is omitted here. In the voice coil control circuit shown in drawing 6 , the direction inclination signal a of a path and the hoop direction inclination signal b are inputted, and a subtractor 31 and an adder 32 generate the difference signal c and the sum signal d, respectively.

[0033] Unlike the 1st example, the focal control signal f is inputted into a voice coil control circuit. The focal control signal f is an error signal for focus servos detected through the objective lens 1, and is given to subtractors 33 and 35 and adders 34 and 36, respectively. A subtractor 33 is 1st operation means which the difference signal c and control signal f of a subtractor 31 are inputted, and generates the subtraction subtraction signal g (=a-b-f). An adder 34 is 2nd operation means which the difference signal c and control signal f of a subtractor 31 are inputted, and generates the subtraction addition signal h (=a-b+f). A subtractor 35 is 3rd operation means which the sum signal d and control signal f of an adder 32 are inputted, and generates the addition subtraction signal i (=a+b-f). An adder 36 is 4th operation means which the sum signal d and control signal f of an adder 32 are inputted, and generates

the addition addition signal j (=a+b+f).
[0034] Next, as shown in drawing 6 , current conversion of the subtraction subtraction signal g is carried out by the driver 37, and it gives voice coil 30d. Current conversion of the subtraction addition signal h is carried out by the driver 38, and it gives voice coil 30a. Current conversion of the addition subtraction signal i is similarly carried out by the driver 39, it gives voice coil 30b, current conversion of the addition addition signal j is carried out by the driver 40, and it gives voice coil 30c. the electromagnetism of the magnetic impression means which will consist of U character mold York 9a and 9b and magnets 10a and 10b if it carries out like this -- an operation -- the subtraction addition driving force F5 occurs in voice coil 30d at voice coil 30a, and the subtraction subtraction driving force F6 occurs in voice coil 30c in the direction of an arrow head of the illustration [the addition addition driving force F7] of the addition subtraction driving force F8 to voice coil 30b.
[0035] Actuation of the optical disk unit of the 2nd example constituted as mentioned above is explained. A radius of gyration is calculated for the angular moment of the direction C of a path generated in a lens holder 2 as 1 like the case of the 1st example. The angular moment according from the y-axis of drawing 7 to the voice coils 30a and 30c of a near side is F5+F7, and the angular moment according from a y-axis side to the voice coils 30b and 30d of the opposite side is F6+F8. Therefore, the comprehensive angular moment Fr of the direction C of a path which sets a revolving shaft as the y-axis becomes the following (3) types.

$$Fr=(F5+F7)+(F6+F8)$$
$$=\{(a+b+f)+(a-b+f)\}$$
$$+\{(a-b-f)+(a+b-f)\}$$
$$=4a \quad \ldots (3)$$

[0036] Moreover, the running torque of the hoop direction D generated in a lens holder 2 is calculated. In drawing 7 , the angular moment according from the x axis of an objective lens 1 to the voice coils 30c and 30d of the opposite side is F7-F6, and the angular moment according from the x axis of an objective lens 1 to the voice coils 30b and 30a of a near side is - (F5-F8). Therefore, in the comprehensive angular moment of the hoop direction D which sets a revolving shaft as a x axis, Ft becomes the following (4) types.

$$Ft=(F7-F6)-(F5-F8)$$
$$=\{(a+b+f)-(a-b-f)\}$$
$$-\{(a-b+f)-(a+b-f)\}$$
$$=4b \quad \ldots (4)$$

[0037] The impetus Ff of the direction of a focus (z-axis) becomes the following (5) types.

$$Ff=F5-F6+F7-F8=(a-b+f)-(a-b-f)$$
$$+(a+b+f)-(a+b-f)$$
$$=4f \quad \ldots (5)$$

[0038] (3) 4a of a formula is what amplified the direction inclination signal a of a path, the drive current proportional to the inclination of the direction of a path is given to voice coils 30a-30d, and the direction inclination of a path of the objective lens 1 to an optical disk 12 is controlled. Moreover, 4b of (4) types is what amplified the hoop direction inclination signal b, the drive current proportional to the inclination of a hoop direction is given to voice coils 30a-30d, and the hoop direction inclination of the objective lens 1 to an optical disk 12 is controlled. Furthermore, 4f of (5) types is what amplified the focal control signal f, the drive current proportional to a gap of the direction of a focus is given to voice coils 30a-30d, and a focus servo commits it.
[0039] While the object lens holder 2 which holds an objective lens 1 by adjusting the above driving force inclines to the direction C of the diameter of a disk, and the disk hoop direction D, the parallel displacement of it is carried out in the direction of a focus. In this way, while amending the inclination of an optical disk 12, the direction of a path of a light beam optical axis, and a hoop direction, the focus of the light beam which irradiates an optical disk through an objective lens 1 can be adjusted. moreover -- if the object lens holder 2 performs suitable energization for the tracking coils 4a-4d -- electromagnetism -- a parallel displacement is carried out in the direction of tracking according to an

operation. For this reason, the tracking of the light beam which irradiates an optical disk 12 through an objective lens 1 can be adjusted.
[0040] The voice coils 30a-30d which became independent electrically as mentioned above are arranged on the hoop direction side face of the object lens holder 2, and hoop direction inclination control, the direction inclination control of a path, and focal control can be made to serve a double purpose with voice coils 30a-30d by acquiring a control signal from the direction inclination signal a of a path, the hoop direction inclination signal b, and the focal control signal f. For this reason, reduction of the components mark of a tilt control device and a focal control device can be performed, and small [of an optical disk unit] and low-pricing can be realized.
[0041]
[Effect of the Invention] This invention can amend the beam optical axis of an objective lens at a high speed to the inclination change under round at the time of rotation of an optical disk by preparing the inclination detection means of the hoop direction which detects the inclination of the beam optical axis and optical disk recording surface which are emitted from an objective lens, and the direction of a path, and two or more tilt coils which control a posture for an object lens holder free [jogging] in the inclination direction of an optical axis as mentioned above. For this reason, generating of the comatic aberration of an objective lens can be made small, and the outstanding optical disk unit in which record playback of a high-definition signal is possible can be realized.

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TECHNICAL FIELD

[Industrial Application] This invention relates to the optical disk unit which enabled it to amend the inclination of the beam optical axis over a disk recording surface at a high speed in a compact disc player (CD player), a laser disc player (LD player), etc.

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PRIOR ART

[Description of the Prior Art] In optical disk regenerative apparatus, such as a CD player and LD player, if the optical axis of a signal regeneration beam leans to the optical disk playback side, optical aberration will occur, a cross talk will increase and a regenerative signal will deteriorate. Moreover, when the optical axis of a signal record beam leans to the optical disk recording surface in the optical disk record regenerative apparatus, degradation of a record signal may be produced and a mistake may be produced in pit formation.
[0003] In the conventional LD player etc., the camber of the direction of a path of a disk is detected as an average amount of camber of a disk round. And there are some in which the tilt control unit which leans the whole optical pickup and controls a beam optical axis by tilt motors, such as a DC motor, was attached.
[0004] In recent years, as for the optical disk unit, high density record-ization is progressing. In order to raise resolution and to perform record playback of high density, an objective lens with large (that is, aperture is large) numerical aperture (NA) is used. However, when aperture of an objective lens was enlarged and the inclination of the beam optical axis over an optical disk playback side arises, the degree of comatic aberration becomes large in proportion to the cube of NA, and the problem that change of the amount of camber under disk round has a bad influence on the record reproducing characteristics of a signal arises.

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EFFECT OF THE INVENTION

[Effect of the Invention] This invention can amend the beam optical axis of an objective lens at a high speed to the inclination change under round at the time of rotation of an optical disk by preparing the inclination detection means of the hoop direction which detects the inclination of the beam optical axis and optical disk recording surface which are emitted from an objective lens, and the direction of a path, and two or more tilt coils which control a posture for an object lens holder free [jogging] in the inclination direction of an optical axis as mentioned above. For this reason, generating of the comatic aberration of an objective lens can be made small, and the outstanding optical disk unit in which record playback of a high-definition signal is possible can be realized.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the optical disk unit which has the tilt control device mentioned above, since the inclination of the whole optical pickup was controlled by a DC motor etc., the response was bad, and tilt control of an optical pickup was not able to be performed so that it might correspond to change of the amount of camber in each include angle while a disk rotates.
[0006] This invention is made in view of such a conventional trouble, and it aims at realizing the optical disk unit which can amend the inclination to the disk recording surface of a beam optical axis at a high speed corresponding to change of the amount of camber under disk round.

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MEANS

[Means for Solving the Problem] Invention of claim 1 of this application is characterized by having the following. The objective lens which condenses light to an optical disk The object lens holder holding an objective lens The supporting material which supports an object lens holder free [jogging] including two or more elastic bodies in the direction of a focus of an optical disk, and the direction of tracking and the inclination direction of the optical axis of an objective lens, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a hoop direction inclination detection means to detect an include-angle gap of a hoop direction, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a direction inclination detection means of a path to detect an include-angle gap of the direction of a path, The pedestal which fixes supporting material, and the focal coil which is wound around the side face of an object lens holder, and drives an object lens holder in the direction of a focus, Two or more tracking coils which are the side faces of an object lens holder, fix on the side face which carries out phase opposite in the hoop direction of an optical disk, or the direction of a path, and drive an object lens holder in the direction of tracking, Two or more tilt coils which are the side faces of an object lens holder, fix on the side face which counters in the hoop direction or the direction of a path of an optical disk, and drive an object lens holder in the inclination direction of an optical axis, The magnetic impression means arranged at the pedestal so that a tracking coil and a tilt coil may be countered, The tilt coil control circuit which controls the drive current passed in each tilt coil based on the output of a hoop direction inclination detection means and the direction inclination detection means of a path, and amends the inclination of the optical axis of an objective lens, the hoop direction of an optical disk, and the direction of a path

[0008] In invention of claim 2 of this application, a tilt coil The 4th tilt coil is arranged on all sides, respectively. a core [optical axis / of an objective lens] -- the 1- with the 1st and 2nd tilt coils The 3rd and 4th tilt coils are attached along the direction of a path of an optical disk. The 2nd and the 4th tilt coil, It is that in which the 1st and 3rd tilt coils are attached along the hoop direction of an optical disk. A tilt coil control circuit A subtraction means to subtract the signal of a hoop direction inclination detection means from the signal of the direction inclination detection means of a path, and to change the subtraction value into the drive current of the 1st and 4th tilt coils, The signal of the direction inclination detection means of a path and the signal of a hoop direction inclination detection means are added, and it is characterized by having an addition means to change the aggregate value into the drive current of the 2nd and 3rd tilt coils.

[0009] Invention of claim 3 of this application is characterized by having the following. The objective lens which condenses light to an optical disk The object lens holder holding an objective lens The supporting material which supports an object lens holder free [jogging] including two or more elastic bodies in the direction of a focus of an optical disk, and the direction of tracking and the inclination direction of the optical axis of an objective lens, The optical axis of light and the recording surface of an optical disk which are emitted from an objective lens, and a hoop direction inclination detection means to detect an include-angle gap of a hoop direction, The optical axis of light and the recording surface of

an optical disk which are emitted from an objective lens, and a direction inclination detection means of a path to detect an include-angle gap of the direction of a path, A focal detection means to detect a gap of the direction of a focus of an objective lens and an optical disk, The pedestal which fixes supporting material, and two or more tracking coils which are the side faces of an object lens holder, fix on the side face which carries out phase opposite in the hoop direction of an optical disk, or the direction of a path, and drive an object lens holder in the direction of tracking, Two or more voice coils which are the side faces of an object lens holder, fix on the side face which counters in the hoop direction or the direction of a path of an optical disk, and drive an object lens holder in the direction of tracking of an optical disk, a hoop direction, and the direction of a path, The magnetic impression means arranged at the pedestal so that a tracking coil and a voice coil may be countered, The voice coil control circuit which controls the drive current passed to two or more voice coils based on the output of a hoop direction inclination detection means, the direction inclination detection means of a path, and a focal detection means, and performs inclination amendment of the optical axis of an objective lens, the hoop direction of an optical disk, and the direction of a path, and focal amendment of coherent light to coincidence

[0010] In invention of claim 4 of this application, a voice coil The 1st - the 4th voice coil are arranged on all sides centering on the optical axis of an objective lens, respectively. The 1st and 2nd voice coils, The 3rd and 4th voice coils are attached along the direction of a path of an optical disk. The 2nd and the 4th tilt coil, It is that in which the 1st and 3rd tilt coils are attached along the hoop direction of an optical disk. A voice coil control circuit The 1st operation means which subtracts the signal of a hoop direction inclination detection means, and the signal of a focal detection means from the signal of the direction inclination detection means of a path, and changes the operation value into the drive current of the 4th voice coil, The 2nd operation means which subtracts the signal of a hoop direction inclination detection means from the sum of the signal of the direction inclination detection means of a path, and the signal of a focal detection means, and changes the operation value into the drive current of the 1st voice coil, The 3rd operation means which subtracts the signal of a focal detection means from the sum of the signal of the direction inclination detection means of a path, and the signal of a hoop direction inclination detection means, and changes the operation value into the drive current of the 2nd voice coil, The signal of the direction inclination detection means of a path, the signal of a hoop direction inclination detection means, and the signal of a focal detection means are added, and it is characterized by having the 4th operation means which changes the operation value into the drive current of the 3rd voice coil.

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OPERATION

[Function] According to invention of claim 1 of this application which has such a description, when the optical axis of an objective lens inclines in the hoop direction or the direction of a path of an optical disk, the direction of a path and a hoop direction inclination detection means output the inclination signal of the direction of a path, and a hoop direction, respectively. The control signal which should be distributed to each tilt coil is calculated using the inclination signal of these hoop directions and the direction of a path. If this result of an operation is changed into a drive current and each tilt coil is given, the optical axis of an objective lens and the inclination of an optical disk will be amended. Moreover, in order to perform amendment of the direction of a focus of an objective lens, and the direction of tracking, the periphery of an object lens holder **** and the drive current for servoes is given to a focal coil and a tracking coil. The drive current which flowed in the tilt coil, the focal coil, and the tracking coil is transformed into electromagnetic force by the magnetic impression means, and attitude control of the objective lens is carried out in the predetermined direction. If it carries out like this, the inclination to the disk recording surface of a beam optical axis can be amended at a high speed to change of the amount of camber under round at the time of rotation of an optical disk. Therefore, the comatic aberration in an objective lens decreases and record playback of a high-definition signal can be performed.
[0012] Moreover, according to invention of claim 4 of this application, two or more driven voice coils which carry out mutually-independent are prepared in the periphery side face of an object lens holder. If a drive current is given to these voice coils using the inclination signal and control signal which are detected, respectively with a hoop direction inclination detection means, the direction inclination detection means of a path, and a focal detection means, a focus servo can be performed without using a focal coil. Moreover, about tilt control of the hoop direction of an objective lens, and the direction of a path, it acts like invention according to claim 1. If it carries out like this, the class of coil attached in an object lens holder will decrease.

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EXAMPLE

[Example] The optical disk unit which contains the tilt control device in the 1st example of this invention below is explained referring to drawing 1 - drawing 5 . Drawing 1 is the decomposition perspective view showing the configuration of the principal part of the optical disk unit of the 1st example. Drawing 2 is the explanatory view which was attached in the optical disk unit and in which inclining and showing the principle of operation of a detection means. Drawing 2 (a) is an important section sectional view in case there is no inclination of a beam optical axis, and drawing 2 (b) is an important section sectional view when the inclination of a beam optical axis arises. Moreover, drawing 3 is the circuit diagram showing the configuration of a tilt coil control circuit, and drawing 4 is the perspective view showing arrangement of the tilt coil attached in the optical disk unit.
[0014] As shown in drawing 1 , the objective lens 1 of an optical pickup is held at the object lens holder 2. The focal coil 3 is horizontally wound around the side face of the object lens holder 2. As shown in drawing 1 , y and the direction of a path of an optical disk are set [the direction of an optical axis of an objective lens 1] to x for the hoop direction of z and an optical disk. In one side face of the hoop direction (the direction of y) of the object lens holder 2, tracking coil 4c and tracking coil 4d which is not illustrated are attached also in the side face of the tracking coils 4a and 4b and another side. The tracking coils 4a-4d are coils wound around the spiral or the curled form, and are coils which pass the drive current for the truck servoes of an optical pickup.
[0015] It is the side face of the hoop direction of the object lens holder 2, and the tilt coils 5a-5d are attached in the part located in each tracking coils [4a-4d] lower part. As shown in drawing 4 , the 1st and 2nd tilt coil 5a and 5b and the 3rd and 4th tilt coil 5c and 5d are arranged along the direction of a path of an optical disk so that it may become a x axis and axial symmetry. In this case, the tilt coils 5a and 5c and the tilt coils 5b and 5d will be arranged along the hoop direction of an optical disk. The tilt coils 5a-5d are also coils wound around the spiral or the curled form, and are coils which pass the drive current for tilt control of an optical pickup. As shown in drawing 1 and drawing 4 , the tilt coils 5a and 5b fix to the near-side side of the object lens holder 2, and fix the tilt coils 5c and 5d on the side face of another side of the object lens holder 2. And as shown in drawing 4 , tilt coil 5a, and 5d, 5b and 5c are respectively connected to the serial.
[0016] Next, the four parallel straight-lines-like supporting material 6a, 6b, 6c, and 6d fixes an end on the side face of the object lens holder 2, and the other end has fixed to the supporting-material fixed part 8. As shown in drawing 1 , supporting material 6a-6d supports the object lens holder 2 possible [jogging and tilting in the four directions of the direction A of a focus (z-axis), the direction B of tracking (x axis), direction inclination C of a path, and hoop direction inclination D].
[0017] The supporting-material fixed part 8 is attached in a pedestal 7 where the object lens holder 2 is held flexibly. A pedestal 7 holds U character mold York 9a and 9b of a pair in the direction of y, and is attached in the upper part of the optical pickup body 13. York 9a and 9b constitutes the magnetic impression means with Magnets 10a and 10b.
[0018] On both sides of the objective lens 1, the direction inclination detectors 11a and 11b of a path are attached in the top face of the object lens holder 2 along x directions. Moreover, on both sides of the

objective lens 1, the hoop direction inclination detectors 11c and 11d are attached along the direction of y. The inclination detectors 11a-11d are photo detectors which receive the diffracted light which does not return to an objective lens 1 among the light reflected with an optical disk 12, after coherent light is emitted from an objective lens 1 and condensed by the optical disk 12, as shown in drawing 2 (a) and (b).

[0019] Next, a tilt coil control circuit is explained using drawing 3 . The signal which inclined from the signal output of inclination detector 11a of drawing 1 , and subtracted the signal output of detector 11b with the subtractor 21 is made into the direction inclination signal a of a path. Moreover, the signal which inclined from inclination detector 11c and subtracted the signal output of 11d of detectors with the subtractor 22 is made into the hoop direction inclination signal b. The subtractor 23 of drawing 3 is the circuit which inclines from the inclination signal a and subtracts Signal b, and outputs the difference signal c (= a-b). Moreover, an adder 24 is the circuit which inclines with the inclination signal a and adds Signal b, and outputs the sum signal d (=a+b). The output of a subtractor 23 is changed into a drive current by the driver 25, and is given to a tilt coils [5a and 5d] series connection object. The output of an adder 24 is similarly changed into a drive current by the driver 26, and is given to the series connection object of the tilt coils 5b and 5c. When a current flows, the tilt coils 5a and 5d shall be connected here so that the electromagnetic force of hard flow may occur mutually. The same is said of the tilt coils 5b and 5d.

[0020] Actuation of the optical disk unit of the 1st example constituted as mentioned above is explained. The diffracted light which does not return to an objective lens 1 among the light which outgoing radiation was carried out from the objective lens 1, and condensed to the optical disk 12 as shown in drawing 1 is received by the direction inclination detectors 11a and 11b of a path, and the hoop direction inclination detectors 11c and 11d. When there is no inclination of a beam optical axis when the object lens holder 2 and an optical disk 12 are parallel namely, the quantity of light received with the two direction inclination detectors 11a and 11b of a path is equal without an objective lens's 1 inclining in the direction C of a path, as shown especially in drawing 1 . In this case, the value of the inclination signal a inputted into the tilt coil control circuit of drawing 3 is set to 0.

[0021] However, when the inclination of the direction of a path occurs in a beam optical axis when the object lens holder 2 and an optical disk 12 are not parallel namely, as shown in drawing 2 (b), a difference arises in the light income of the direction inclination detectors 11a and 11b of a path, and the direction inclination signal a of a path turns into a forward or negative signal according to the inclination direction and the amount of inclinations.

[0022] Moreover, the hoop direction inclination signal b occurs by 11d also about the hoop direction D shown in drawing 1 by hoop direction inclination detector 11c and the same principle as the above. These inclination signals a and b are inputted into the subtractor 23 and adder 24 of drawing 3 , and are changed into the difference signal c and the sum signal d. And the difference signal c is changed into a drive current by the driver 25, and this current is given to the tilt coils 5a and 5d of drawing 5 . Moreover, the Kazunobu number d is changed into a drive current by the driver 26, and this current is given to the tilt coils 5b and 5c.

[0023] electromagnetism with the magnetic circuit which consists of U character mold York 9a and 9b of drawing 1 , and magnets 10a and 10b -- according to an operation, as the arrow head of drawing 4 shows, the difference driving force F1 and F2 occurs in the tilt coils 5a and 5d, respectively. The sum driving force F4 and F3 occurs in the tilt coils 5b and 5c similarly, respectively. The difference driving force F1 and F2 turned to the opposite direction mutually, and the sum driving force F3 and F4 has also turned to the opposite direction mutually. Moreover, the difference driving force F1 and the sum driving force F3 turned to the same direction, and the difference driving force F2 and the sum driving force F4 have also turned to the same direction.

[0024] A radius of gyration is calculated for the angular moment of the direction C of a path generated in a lens holder 2 here as 1. In drawing 4 , the angular moment according from the y-axis of an objective lens 1 to the tilt coils 5a and 5c of a near side is F1+F3, and the angular moment according from the y-axis of an objective lens 1 to the tilt coils 5b and 5d of the opposite side is F2+F4. Therefore, the

comprehensive angular moment Fr of the direction of a path which sets a revolving shaft as the y-axis becomes the following (1) type.

$$Fr=(F1+F3)+(F2+F4)$$
$$=\{(a-b)+(a+b)\}$$
$$+\{(a-b)+(a+b)\}$$
$$=4a \quad \ldots (1)$$

[0025] Moreover, a radius of gyration is calculated for the angular moment of the hoop direction D generated in a lens holder 2 as 1. In drawing 4 , the angular moment according from the x axis of an objective lens 1 to the tilt coils 5c and 5d of the opposite side is F3-F2, and the angular moment according from the x axis of an objective lens 1 to the tilt coils 5b and 5a of a near side is F4-F1. Therefore, the comprehensive angular moment Ft of the hoop direction which sets a revolving shaft as a x axis becomes the following (2) types.

$$Ft=(F3-F2)+(F4-F1)$$
$$=\{(a+b)-(a-b)\}$$
$$+\{(a+b)-(a-b)\}$$
$$=4b \quad \ldots (2)$$

[0026] (1) 4a of a formula is what amplified the direction inclination signal a of a path, and it turns out that the drive current proportional to the inclination of the direction of a path is given to the tilt coils 5a-5d, and the inclination of the direction C of a path of the objective lens 1 to an optical disk 12 is controlled. Moreover, 4b of (2) types is what amplified the hoop direction inclination signal b, and it turns out that the drive current proportional to the inclination of a hoop direction is given to the tilt coils 5a-5d, and the inclination of the hoop direction D of an objective lens 1 is controlled. As for the object lens holder 2, a specified quantity inclination and the inclination of an optical disk 12, the direction of a path of a light beam optical axis, and a hoop direction are amended by the direction C of a path of a disk, and the hoop direction D of a disk as mentioned above, respectively.

[0027] On the other hand, the parallel displacement of the object lens holder 2 is carried out in the direction of tracking by carrying out suitable energization for the tracking coils 4a-4d. For this reason, the tracking of the light beam which irradiates an optical disk 12 through an objective lens 1 can be adjusted. moreover -- if suitable energization for the focal coil 3 is performed -- electromagnetism -- the object lens holder 2 carries out a parallel displacement in the direction of a focus according to an operation. Thus, the focus of the light beam which irradiates an optical disk 12 through an objective lens 1 can be adjusted.

[0028] The inclination signal generated as mentioned above with the direction inclination detectors 11a and 11b of a path and the hoop direction inclination detectors 11c and 11d is given to a tilt coil control circuit, those sum signals and difference signals are built, and it energizes based on these to two tilt coils 5a and 5c and 5b and 5d. If it carries out like this, a high speed can be compensated for the optical-axis inclination of the light beam emitted from an objective lens 1 to inclination change of the direction of a path under round of the rotating optical disk, and a hoop direction. By the further above-mentioned configuration, the attitude control of the direction of a path and a hoop direction can be used together with two pairs of tilt coils, and a tilt control unit can be made into a low price by that which can perform reduction of components mark.

[0029] Next, it attaches about the optical disk unit containing the tilt control device in the 2nd example of this invention, and it explains, referring to drawing 5 - drawing 7 . Drawing 5 is the decomposition perspective view showing the configuration of the principal part of the optical disk unit of the 2nd example. Drawing 6 is the circuit diagram showing the configuration of a voice coil control circuit, and drawing 7 is the important section perspective view of the voice coil attached in the optical disk unit of the 2nd example.

[0030] In drawing 5 - drawing 7 , the same sign is attached to the configuration member which has the same function as the 1st example, and those explanation is omitted. A different part from the 1st example is the point of transposing the focal coil 3 and the tilt coils 5a-5d of drawing 1 to the voice coils 30a, 30b, 30c, and 30d which became independent electrically, and making the focal coil and the tilt coil

serve a double purpose.
[0031] In drawing 5 , it is the side face of the hoop direction of the object lens holder 2, and voice coils 30a-30d are attached in the part located in the tracking coils [4a-4d] lower part. As shown in drawing 7 , it is arranged along the direction of a path of an optical disk the 1st voice coil 30a and 2nd voice coil 30b, and the 3rd voice coil 30c and 4th voice coil 30d so that it may become a x axis and axial symmetry. In this case, voice coils 30a and 30c and voice coils 30b and 30d will be arranged along the hoop direction of an optical disk. Voice coils 30a-30d are also coils wound around the spiral or the curled form, and are coils which pass the drive current tilt control of an optical pickup, and for focal control. As shown in drawing 5 and drawing 7 , voice coils 30a and 30b fix on the side face of the near side of the object lens holder 2, and fix voice coils 30c and 30d on the side face of another side of the object lens holder 2. And as shown in drawing 7 , voice coils 30a, 30b, 30c, and 30d are connected to the driver so that a drive current may be supplied independently.
[0032] The voice coil control circuit of the optical disk unit of the 2nd example constituted as mentioned above is explained. In addition, since the detection approach of an inclination detecting signal is the same as that of the 1st example, explanation is omitted here. In the voice coil control circuit shown in drawing 6 , the direction inclination signal a of a path and the hoop direction inclination signal b are inputted, and a subtractor 31 and an adder 32 generate the difference signal c and the sum signal d, respectively.
[0033] Unlike the 1st example, the focal control signal f is inputted into a voice coil control circuit. The focal control signal f is an error signal for focus servos detected through the objective lens 1, and is given to subtractors 33 and 35 and adders 34 and 36, respectively. A subtractor 33 is 1st operation means which the difference signal c and control signal f of a subtractor 31 are inputted, and generates the subtraction subtraction signal g (=a-b-f). An adder 34 is 2nd operation means which the difference signal c and control signal f of a subtractor 31 are inputted, and generates the subtraction addition signal h (=a-b+f). A subtractor 35 is 3rd operation means which the sum signal d and control signal f of an adder 32 are inputted, and generates the addition subtraction signal i (=a+b-f). An adder 36 is 4th operation means which the sum signal d and control signal f of an adder 32 are inputted, and generates the addition addition signal j (=a+b+f).
[0034] Next, as shown in drawing 6 , current conversion of the subtraction subtraction signal g is carried out by the driver 37, and it gives voice coil 30d. Current conversion of the subtraction addition signal h is carried out by the driver 38, and it gives voice coil 30a. Current conversion of the addition subtraction signal i is similarly carried out by the driver 39, it gives voice coil 30b, current conversion of the addition addition signal j is carried out by the driver 40, and it gives voice coil 30c. the electromagnetism of the magnetic impression means which will consist of U character mold York 9a and 9b and magnets 10a and 10b if it carries out like this -- an operation -- the subtraction addition driving force F5 occurs in voice coil 30d at voice coil 30a, and the subtraction subtraction driving force F6 occurs in voice coil 30c in the direction of an arrow head of the illustration [the addition addition driving force F7] of the addition subtraction driving force F8 to voice coil 30b.
[0035] Actuation of the optical disk unit of the 2nd example constituted as mentioned above is explained. A radius of gyration is calculated for the angular moment of the direction C of a path generated in a lens holder 2 as 1 like the case of the 1st example. The angular moment according from the y-axis of drawing 7 to the voice coils 30a and 30c of a near side is F5+F7, and the angular moment according from a y-axis side to the voice coils 30b and 30d of the opposite side is F6+F8. Therefore, the comprehensive angular moment Fr of the direction C of a path which sets a revolving shaft as the y-axis becomes the following (3) types.

$$Fr=(F5+F7)+(F6+F8)$$
$$=\{(a+b+f)+(a-b+f)\}$$
$$+\{(a-b-f)+(a+b-f)\}$$
$$=4a \quad \ldots (3)$$

[0036] Moreover, the running torque of the hoop direction D generated in a lens holder 2 is calculated. In drawing 7 , the angular moment according from the x axis of an objective lens 1 to the voice coils 30c

and 30d of the opposite side is F7-F6, and the angular moment according from the x axis of an objective lens 1 to the voice coils 30b and 30a of a near side is - (F5-F8). Therefore, in the comprehensive angular moment of the hoop direction D which sets a revolving shaft as a x axis, Ft becomes the following (4) types.

Ft=(F7-F6)-(F5-F8)
={(a+b+f)-(a-b-f)}
-{(a-b+f)-(a+b-f)}
= 4b ... (4)

[0037] The impetus Ff of the direction of a focus (z-axis) becomes the following (5) types.

Ff=F5-F6+F7-F8=(a-b+f)-(a-b-f)
+(a+b+f)-(a+b-f)
= 4f ... (5)

[0038] (3) 4a of a formula is what amplified the direction inclination signal a of a path, the drive current proportional to the inclination of the direction of a path is given to voice coils 30a-30d, and the direction inclination of a path of the objective lens 1 to an optical disk 12 is controlled. Moreover, 4b of (4) types is what amplified the hoop direction inclination signal b, the drive current proportional to the inclination of a hoop direction is given to voice coils 30a-30d, and the hoop direction inclination of the objective lens 1 to an optical disk 12 is controlled. Furthermore, 4f of (5) types is what amplified the focal control signal f, the drive current proportional to a gap of the direction of a focus is given to voice coils 30a-30d, and a focus servo commits it.

[0039] While the object lens holder 2 which holds an objective lens 1 by adjusting the above driving force inclines to the direction C of the diameter of a disk, and the disk hoop direction D, the parallel displacement of it is carried out in the direction of a focus. In this way, while amending the inclination of an optical disk 12, the direction of a path of a light beam optical axis, and a hoop direction, the focus of the light beam which irradiates an optical disk through an objective lens 1 can be adjusted. moreover -- if the object lens holder 2 performs suitable energization for the tracking coils 4a-4d -- electromagnetism -- a parallel displacement is carried out in the direction of tracking according to an operation. For this reason, the tracking of the light beam which irradiates an optical disk 12 through an objective lens 1 can be adjusted.

[0040] The voice coils 30a-30d which became independent electrically as mentioned above are arranged on the hoop direction side face of the object lens holder 2, and hoop direction inclination control, the direction inclination control of a path, and focal control can be made to serve a double purpose with voice coils 30a-30d by acquiring a control signal from the direction inclination signal a of a path, the hoop direction inclination signal b, and the focal control signal f. For this reason, reduction of the components mark of a tilt control device and a focal control device can be performed, and small [of an optical disk unit] and low-pricing can be realized.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the decomposition perspective view showing the configuration of the optical disk unit in the 1st example of this invention.
[Drawing 2] When (a) does not have the inclination of the beam optical axis of an inclination detection means in the optical disk unit of the 1st example, (b) is an explanatory view of operation when an inclination arises.
[Drawing 3] It is the block diagram of a tilt coil control circuit used for the optical disk unit of the 1st example.
[Drawing 4] It is the important section perspective view of the tilt coil attached in the optical disk unit of the 1st example.
[Drawing 5] It is the decomposition perspective view showing the configuration of the optical disk unit in the 2nd example of this invention.
[Drawing 6] It is the block diagram of a voice coil control circuit used for the optical disk unit of the 2nd example.
[Drawing 7] It is the important section perspective view of the voice coil attached in the optical disk unit of the 2nd example.
[Description of Notations]
1 Objective Lens
2 Object Lens Holder
3 Focal Coil
4a-4d Tracking coil
5a-5d Tilt coil
6a-6d Supporting material
7 Pedestal
8 Supporting-Material Fixed Part
9a, 9b U character mold York
10a, 10b Magnet
11a, 11b The direction inclination detector of a path
11c, 11d Hoop direction inclination detector
12 Optical Disk
13 Optical Pickup Body
21, 22, 23, 31, 33, 35 Subtractor
24, 32, 34, 36 Adder
25, 26, 37-40 Driver
30a-30d Voice coil
A The direction of a focus
B The direction of tracking
C The direction inclination of a path

D Hoop direction inclination

[Translation done.]

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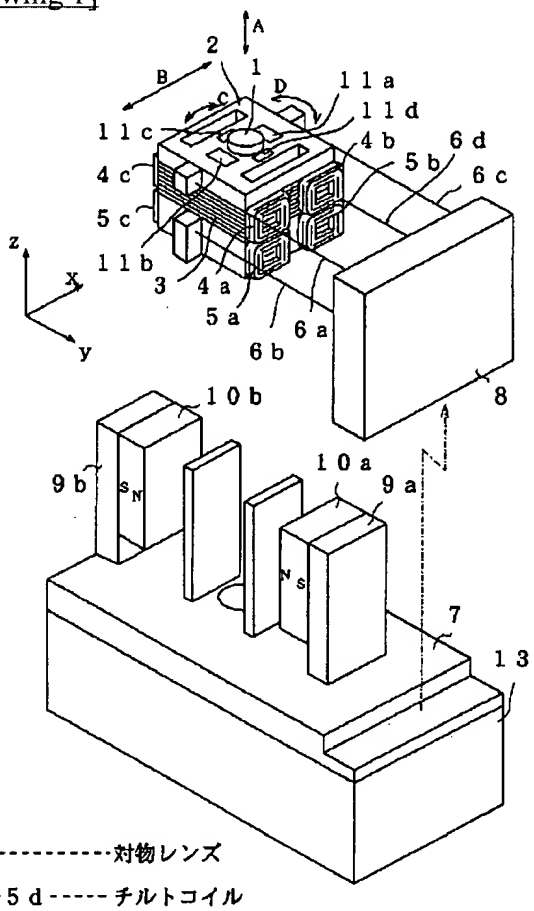
DRAWINGS

[Drawing 1]

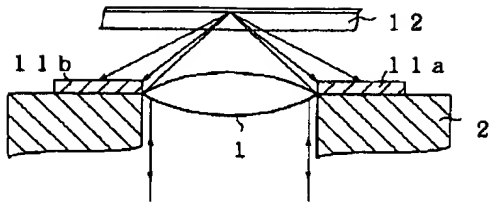


1 ----------対物レンズ

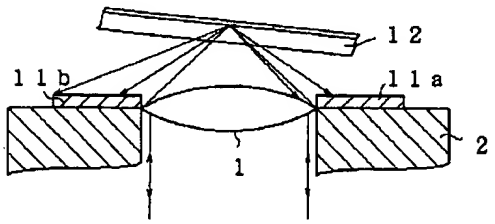
5 a～5 d -----チルトコイル

[Drawing 2]

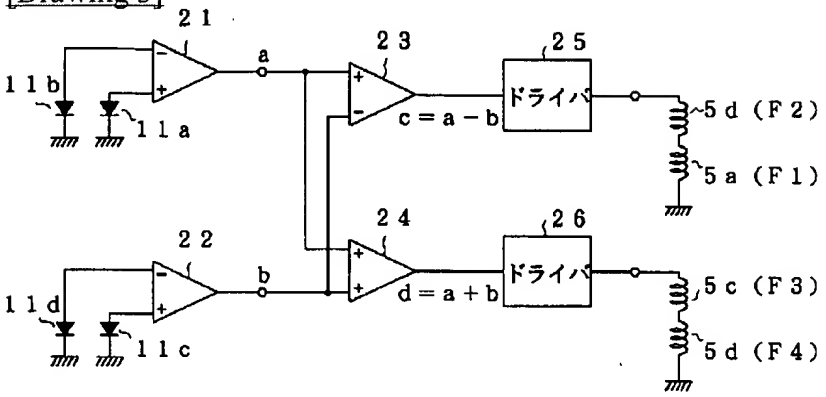
(a)



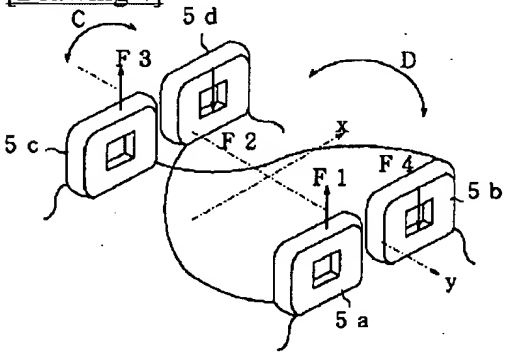
(b)



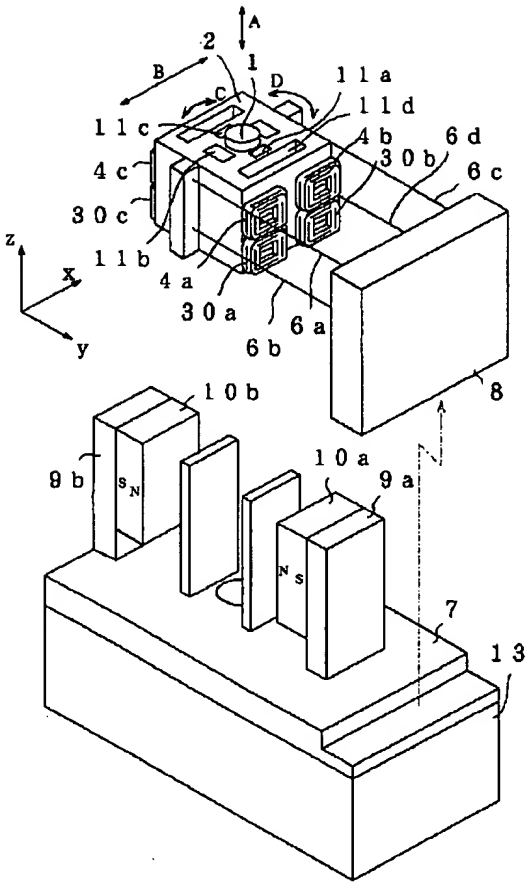
[Drawing 3]



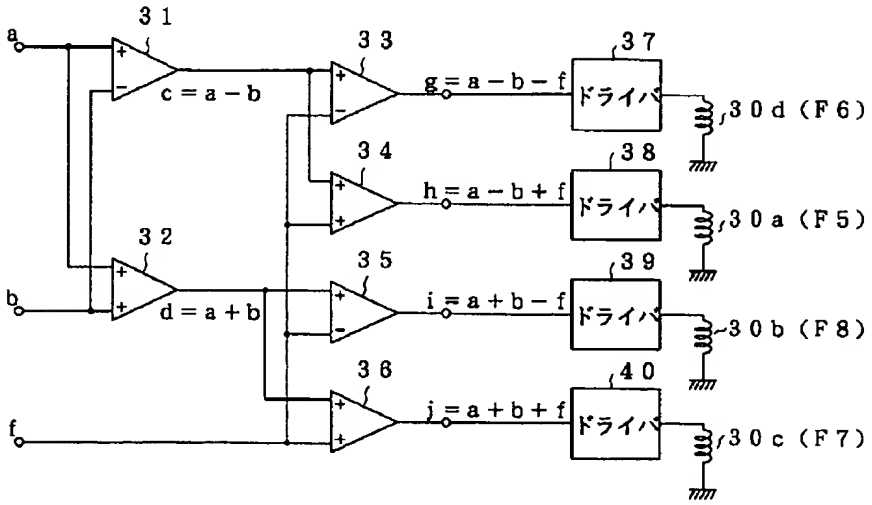
[Drawing 4]



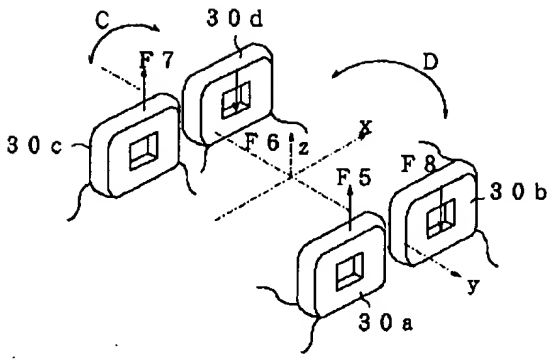
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]